

CLAIMS

1. A cell for electrowinning aluminium from alumina, comprising:
 - 5 - a metal-based anode having an outer part that has an electrochemically active oxide-based surface and that contains at least one of nickel, cobalt and iron;
 - a fluoride-containing molten electrolyte in which the active anode surface is immersed and which is at a temperature below 940°C, in particular in the range
10 from 880° to 920°C, and which consists of:
 - 5 to 14 weight% dissolved alumina;
 - 35 to 45 weight% aluminium fluoride;
 - 30 to 45 weight% sodium fluoride;
 - 5 to 20 weight% potassium fluoride;
 - 15 - 0 to 5 weight% calcium fluoride; and
 - 0 to 5 weight% in total of one or more further constituents.
2. The cell of claim 1, wherein the electrolyte contains 7 to 10 weight% alumina.
- 20 3. The cell of claim 1 or 2, wherein the electrolyte contains 38 to 42 weight% aluminium fluoride.
4. The cell of any preceding claim, wherein the electrolyte contains 34 to 43 weight% sodium fluoride.
5. The cell of any preceding claim, wherein the
25 electrolyte contains 8 to 15 weight% potassium fluoride.
6. The cell of any preceding claim, wherein the electrolyte contains 2 to 4 weight% calcium fluoride.
7. The cell of any preceding claim, wherein the electrolyte contains 0 to 3 weight% of said one or more
30 further constituents.
8. The cell of any preceding claim, wherein said one or more further constituents comprise at least one fluoride selected from magnesium fluoride, lithium fluoride, cesium fluoride, rubidium fluoride, strontium
35 fluoride, barium fluoride and cerium fluoride.

9. The cell of any preceding claim, comprising a cathode that has an aluminium-wettable surface, in particular a horizontal or inclined drained surface.
10. The cell of claim 9, wherein the cathode has an aluminium-wettable coating that comprises a refractory boride and/or an aluminium-wetting oxide.
11. The cell of any preceding claim, wherein the anode has a metallic or cermet body and an oxide layer on the anode body.
12. The cell of any preceding claim, wherein the anode body is made from an iron alloy containing nickel and/or cobalt.
13. The cell of claim 12, wherein the anode body is made from an alloy consisting of:
- 40 to 80% nickel and/or cobalt, in particular 50 to 60 weight%;
 - 9 to 55 weight% iron, in particular 25 to 40 weight%;
 - 5 to 15 weight% copper, in particular 6 to 12 weight%;
 - 0 to 4 weight% in total of at least one of aluminium, niobium and tantalum, in particular 0.5 to 2 weight%; and
 - 0 to 2 weight% in total of further constituents, in particular 0.5 to 1 weight%.
14. The cell of claim 12 or 13, wherein the anode body is covered with an integral iron oxide-based layer containing up to 35 weight% nickel oxide and/or cobalt oxide, in particular from 5 to 10 weight% nickel oxide.
15. The cell of any preceding claim, wherein the anode comprises an applied iron oxide-based coating.
16. The cell of claim 15, wherein the anode coating contains Fe_2O_3 and optionally: at least one dopant selected from TiO_2 , ZnO and CuO and/or at least one inert material selected from nitrides and carbides.
17. The cell of any preceding claim, wherein the anode comprises a cerium oxyfluoride-based outermost coating.
18. The cell of any preceding claim, wherein the anode is suspended in the electrolyte by a nickel-containing stem, in particular a stem having a nickel-containing core covered with an applied oxide coating.

19. The cell of claim 18, wherein the nickel containing stem is covered with an applied coating containing aluminium oxide and titanium oxide.

20. The cell of claim 18 or 19, wherein the core of the stem comprises a copper inner part and a nickel-based outer part.

21. The cell of any preceding claim, comprising at least one component that contains a sodium-active cathodic material, such as elemental carbon, said sodium-active cathodic material being shielded from the electrolyte by a sodium-inert layer to inhibit the presence in the molten electrolyte of soluble cathodically-produced sodium metal that constitutes an agent for dissolving the active oxide-based anode surface.

22. A cell according to claim 1, comprising:

- a metal-based anode having an outer part that has an electrochemically active oxide-based surface and that is made from an alloy consisting of:
 - 50 to 60 weight% in total of nickel and/or cobalt;
 - 25 to 40 weight% iron;
 - 6 to 12 weight% copper;
 - 0.5 to 2 weight% aluminium and/or niobium; and
 - 0.5 to 1.5 weight% in total of further constituents,the anode comprising an applied hematite-based coating and optionally a cerium oxyfluoride-based outermost coating;
- a nickel-containing anode stem for suspending the anode in the electrolyte, the stem being covered with a coating of aluminium oxide and titanium oxide;
- a fluoride-containing molten electrolyte in which the active anode surface is immersed and which is at a temperature in the range from 880° to 930°C and which consists of:
 - 7 to 10 weight% dissolved alumina;
 - 38 to 42 weight% aluminium fluoride;
 - 34 to 43 weight% sodium fluoride;
 - 8 to 15 weight% potassium fluoride;
 - 2 to 4 weight% calcium fluoride; and
 - 0 to 3 weight% in total of one or more further constituents;

and

- a cathode having an aluminium-wettable surface, in particular a drained horizontal or inclined surface, formed by an aluminium-wettable coating of refractory hard material and/or aluminium-wetting oxide.

23. A method of electrowinning aluminium in a cell as defined in any preceding claim, comprising electrolysing the dissolved alumina to produce oxygen on the anode and aluminium cathodically, and supplying alumina to the electrolyte to maintain therein a concentration of dissolved alumina of 5 to 14 weight%, in particular 7 to 10 weight%.